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PROJECT PLAN

for the

VASQUEZ BOULEVARD AND I-70 RESIDENTIAL RISK-BASED SAMPLING

STAGE III INVESTIGATION

DENVER, CO

June 1999

Prepared For:
U.S. Environmental Protection Agency, Region VIII
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Denver, CO 80202

Prepared by:
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Contract No.: SBAHQ-97-D-0003

A1 APPROVAL PAGE

This Project Plan for the Vasquez Boulevard and I-70 Residential Risk-based Sampling Stage III Investigation has been prepared at the request of the U.S. Environmental Agency, Region 8, by ISSI, Inc. Study investigations and activities addressed in this Project Plan are approved without conditions.

______________________________ ____________

Program Approval . date
Bonita Lavelle
EPA Remedial Project Manager
Vasquez Boulevard and I-70 Site

______________________________ ____________

Program Approval date
Peter Stevenson
EPA On Scene Coordinator
Vasquez Boulevard and I-70 Site

______________________________ ____________

Technical Approval date
Christopher Weis, PhD, DABT
EPA Regional Toxicologist
Office of Ecosystems Protection and Remediation

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A3 DISTRIBUTION LIST

This Draft Vasquez Boulevard and I-70 Residential Risk-based Sampling - Stage III Investigation Project Plan and any revisions will be distributed as follows:

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A4 PROJECT TASK AND ORGANIZATION

A4.1 Project Task

EPA Region VIII is working in cooperation with the City and County of Denver and the Colorado Department of Public Health and Environment (CDPHE) to further characterize surface soils and other environmental and biologic media at residences in the Vasquez Boulevard and I-70 Site. This document serves as the Sampling and Analysis Plan and Quality Assurance Project Plan (SAP/QAPP) for the project and presents the organization, objectives, functional activities and specific quality assurance and quality control activities associated with this investigation. This SAP/QAPP includes site background information, project objectives and scope, sampling design and rationale, analytical design and rationale and data quality objectives (DQOs) to support these activities. It describes the specific protocols that will be followed for sampling, processing of samples, storage, chain of custody, and laboratory analyses.

A4.2 Project Organization

The following lists key personnel who will serve as contacts and provide technical expertise during implementation of this Project Plan.

U.S. Environmental Protection Agency

- Bonita Lavelle, EPA Remedial Project Manager, will be responsible for overall project management, technical oversight and coordination among EPA and its contractors, the State of Colorado and the City and County of Denver. Ms. Lavelle will be a principal decision-maker for this project.

- Peter Stevenson, EPA On-Scene Coordinator, will be responsible for implementing and documenting some of the field sampling activities in accordance with this SAP/QAPP.

- Christopher P. Weis, Ph.D., EPA Regional Toxicologist, will serve as the primary technical contact for this project. He will be responsible for evaluating the human health risk to residents of Vasquez Boulevard and I-70 site. Dr. Weis will be a principal data user and decision-maker for this project.

- William Brattin, Ph.D., ISSI, Inc., will be responsible for managing ISSI's activities which include: preparation of planning documents, providing technical oversight, and compiling and summarizing data generated during the supplemental investigations. Dr. Brattin will be a principal data user for this project.

A5 PROBLEM DEFINITION AND BACKGROUND

A5.1 Background

In the Spring of 1998, a large-scale surface soil sampling program was implemented to determine the nature and extent of heavy metal contamination within the Vasquez Boulevard and I-70 Site. Note that boundaries had not yet been delineated for this site. The Spring 1998 investigation, carried out on behalf of the USEPA Region 8 by URS Operating Services (UOS), measured bulk concentrations of arsenic, cadmium and lead in approximately 2400 surface soil samples. Each of the nearly 2400 surface soil sample locations were collected individually (grab sample), typically with one sample from the front yard and one sample from the back yard of each residential property. The raw surface soil was homogenized and sieved to particles less than 2 mm ("bulk" soil) prior to concentration measurement. The range of concentrations for these surface soils were:

Analyte	Concentration Range (ppm)
Arsenic	< 44 – 5600
Cadmium[a]	< 96 – 120
Lead	< 28 – 8000

a – Although concentration ranges are available within the UOS Surface Soil Database, these data were determined unusable and were, therefore not reported in the UOS final report (USEPA 1998b).

As a result of the comprehensive surface soil investigation performed by UOS in Spring 1998, approximately 37 residences were identified as having surface soil concentrations in the front and/or back yard above the removal action levels of 400 ppm for arsenic and 2,000 ppm for lead. These action levels have been defined to identify residences that may require immediate soil removal. The extent of soils with elevated arsenic concentrations appears to be randomly distributed throughout the residences. Therefore, a phase III investigation is being conducted to further characterize the nature and extent of elevated arsenic concentrations found in residential soils.

A6 PROJECT TASK DESCRIPTION

This section outlines the overall study goals and study objectives of the Vasquez Boulevard and I-70 Residential Risk-based Sampling - Stage III Investigation. The study goals outline the unique endpoints that are desired at the completion of the project. The study objectives identify the steps required to attain each goal.

A6.1 Study Goals

STUDY GOALS: EPA has **X** distinct goals for this study as outlined below:

1) Characterize the nature and extent of arsenic (As) contamination throughout residential yards by performing **high-density ("intensive")** sampling of **surface soil and soil cores. Characterize a fraction of the surface and core**

soils for an extensive list of metals (Section B4.2.1) to evaluate potential contaminants of concern (PCOCs).

2) **Quantify the concentrations of arsenic, cadmium, lead and zinc in the following environmental media at residences identified for soil removal action:**

   - **indoor household dust (As, Cd, Pb, Zn)**
   - **undisturbed dust (As, Cd, Pb, Zn)**
   - **tap water (Pb only)**
   - **exterior and interior paint (Pb only)**
   - **garden vegetables (As, Cd, Pb, Zn)**
   - **surface soil samples co-located with garden vegetables (As, Cd, Pb, Zn)**

3) **Estimate the extent to which residents at properties identified for soil removal action are presently exposed to arsenic and lead by performing a voluntary human biomonitoring program to quantify levels of these metals in biological media. Three parameters will be measured as part of the biomonitoring program:**

   - **Arsenic in composite hair samples**
   - **Inorganic arsenic in first void urine samples**
   - **Blood lead**

It is envisioned that this investigation will proceed in two distinct phases. The first phase will implement the objectives for Study Goal #1 (Intensive Surface Soil and Core Sampling). The second phase (Environmental Sampling and Biomonitoring at Selected Residences) will proceed after residences requiring soil removal action are identified.

A6.2 Study Objectives

This project consists of several steps to define the magnitude of possible arsenic distribution in residential soil at the Vasquez Boulevard and I-70 Site. The objectives for each study goal and their intended use are outlined in subsequent paragraphs.

STUDY GOAL #1

Study Objective #1-1: **Choose the 5 residences within the study area having the greatest reported surface soil arsenic concentration in the Spring 1998 sampling program (USEPA 1998b). Collect surface soil samples on a 5'x5' grid to characterize the spatial relationship of metals (As, Cd, Pb, Zn) concentrations at each property. Whenever possible, this grid sampling program will extend out approximately 15 feet (3 grid nodes) to properties adjacent to the targeted residences where yards are contiguous. This information will be used to:**

1) Determine the mean metals concentrations for the front and back yards at each residence. Evaluate whether metals concentrations differ significantly between front and back yards.

2) Evaluate the spatial distribution of arsenic and lead concentrations at the target residence in order to judge whether the grab sample concentrations for each residence (reported by UOS) represent an anomalous impacted zone on the property, identifies an authentic region of high arsenic or lead concentration (hot spot) or accurately represents the average metals concentration observed for the entire property.

3) Evaluate the spatial distribution of arsenic and lead concentrations in the surface soil of contiguous yards in order to judge whether lead and arsenic concentrations are similar or dissimilar from the target residence.

Study Objective #1-2: Choose 3 residences within the study area, identified by the UOS investigation, which are below the removal action levels (defined as unimpacted) (USEPA 1998b). Collect surface soil samples on a 5'x 5' grid to characterize the spatial relationship of metals (As, Cd, Pb, Zn) concentrations at the property. Whenever possible, this grid sampling will extend out approximately 15 feet to properties adjacent to the targeted residences where yards are contiguous. This information will be used to:

1) Determine the mean metals concentrations for the front and back yards at each residence. Evaluate whether concentrations differ significantly between front and back yards.

2) Evaluate the spatial distribution of arsenic and lead concentrations at the unimpacted residence in order to judge whether the grab sample concentrations for each residence (reported by UOS) represent an anomalous unimpacted zone on the property, identifies an authentic region of low arsenic or lead concentration or accurately represents the average metals concentration observed for the entire property.

3) Evaluate the spatial distribution of arsenic and lead concentrations in the contiguous yards in order to judge whether lead and arsenic concentrations are significantly similar or dissimilar from the unimpacted residence.

Study Objective #1-3: Collect four core samples (2 front yard cores and 2 backyard cores) from each of the 5 target residences and 3 unimpacted residences. Core samples will be 2-12 inches in depth and will be used to determine depth profile and to evaluate if buried sources may exist. The core sample will be fractioned into 2-inch intervals and each depth interval will be containerized separately. These samples will be analyzed for arsenic, cadmium, lead and zinc and then archived for

possible phase speciation and particle sizing. The decision to perform additional analyses will be made by the RPM and Regional Toxicologist after preliminary core soil results are available. This information will be used to:

1) **Determine what arsenic, cadmium, lead and zinc concentrations are present in each core sample.**
2) **Determine whether visual inspection of the core uncovers an observed stratification of soil contamination, for example: native soils stratified with other types of fill material.**
3) **Using phase speciation and particle sizing, determine potential sources of soils present at the residence.**

<u>Study Objective #1-4</u>: After the initial analysis of all surface and core soils (discussed in Study Objectives #1-1 to #1-3) which quantified arsenic, cadmium, lead and zinc concentrations in each sample, a subset of approximately 20% (N ≥ 30) of surface soils and approximately 30% (N ≥ 7) of core samples will be identified for analysis for a full suite of PCOC metals (Section B4.2). This information will be used to:

1) **Determine if any metals are present in quantities above proposed health-based goals (Section B4.2.1).**
2) **Determine what, if any, metals are useful indicators for source attribution.**

<u>Overall Study Goal #1 Data Evaluation</u>:
Data from each of the impacted and unimpacted residences will then be compared to determine the following:

1) **Determine whether the mean arsenic, cadmium, lead and zinc concentrations found at impacted and unimpacted residences are statistically different.**
2) **Determine if any single residence or group of residences report mean arsenic and/or lead concentrations for either the front yard or the back yard above the removal action levels.**

<u>STUDY GOAL #2</u>
Study Goal #2 will be carried out only after residences have been identified for soil removal. This will be determined by an investigation performed by the On-Scene Coordinator that is not part of the scope of this Project Plan.

<u>Study Objective #2-1</u>: Collect indoor household dust and undisturbed dust samples from each residence identified for soil removal. Household dust samples will be collected in the main living space of the residence. Undisturbed dust samples will be collected in the attic (if it is not used as a living space). All samples will be analyzed for arsenic, cadmium, lead and zinc by XRF. After analysis, all samples will be archived for possible future lead and arsenic speciation and particle sizing analyses

or quantification of additional metals. The decision to perform additional analyses will be made by the RPM and Regional Toxicologist after preliminary concentration data are available. Standard operating procedures for speciation and particle sizing are located in Appendix A.

<u>Study Objective #2-2</u>: ~~Using the same residences chosen for Study Objective #2-1, collect first morning flush and~~ post-flush tap water ~~samples from each residence which will be analyzed for lead.~~

<u>Study Objective #2-3</u>: ~~Using~~ the same residences ~~chosen for Study Objective #2-1, perform field screening to quantify the levels of lead paint present on indoor and~~ outdoor surfaces of target homes.

<u>Overall Study Goal #2 Data Evaluation</u>:
These environmental data will be used to quantify potential sources of arsenic or lead exposure and to improve estimates of risk to humans. Data will also be used to characterize levels of cadmium and zinc present in these media. In addition, these data will be used to refine the fate and transport component of the conceptual site model by investigating the relationship between:

- **soil-arsenic vs. house dust-arsenic**
- **soil-arsenic vs. undisturbed dust-arsenic**
- **soil-lead vs. house dust-lead**
- **soil-lead vs. undisturbed dust-lead**
- **paint-lead vs. house dust-lead**
- **paint-lead vs. undisturbed dust-lead**
- **soil-metal vs. house dust-metal (metal = cadmium or zinc)**
- **soil-metal vs. undisturbed dust-metal (metal = cadmium or zinc)**

<u>STUDY GOAL #3</u>

<u>Study Objective #3-1</u>: Using the same residences chosen for Study Goal #2 as the population group, measure the levels of arsenic present in composite hair samples and first morning void urine samples for all willing members of each household. These data will be used to estimate whether acute or subchronic exposures to arsenic have potentially occurred, and if so, to what extent.

<u>Study Objective #3-2</u>: Using the same residences chosen for Study Goal #2 as the population group, collect blood lead samples from children ages 6-72 months (with parental consent). These data will be used to estimate the actual lead exposure levels in the children. Because the number of children present at these residences is presently unknown, it is uncertain whether a sufficient number of children will be recruited to perform a meaningful quantitative evaluation of the mean blood lead values for this study region. In the event that a meaningful statistical evaluation of blood lead values for the Vasquez Boulevard and I-70 site community cannot be

determined, these data will be used only to judge if a particular child's blood lead concentration is above a level of health concern.

Study Objective #3-3: **Using the same residences chosen for Study Goal #2 as the population group, administer in-home questionnaires that will be used to provide additional information pertinent to evaluate potential arsenic and lead exposures.**

Overall Study Goal #3 Data Evaluation:

This information will be used to determine whether arsenic or lead exposures to residents within the study area are significantly:

a) higher than national averages or exceeds EPA guidelines for child blood lead values; or
b) above a level of health concern

As a secondary goal, the biological data will be used in tandem with demographic and environmental data to quantify the following relationships, providing sufficient data are available:

1) Determine whether a statistically significant relationship (α >0.95) is present between:

- **soil-arsenic vs. urine-arsenic**
- **soil-arsenic vs. hair-arsenic**
- **soil-lead vs. blood-lead**
- **house dust-lead vs. blood-lead**
- **undisturbed dust-lead vs. blood-lead**
- **paint-lead vs. house dust-lead**
- **paint-lead vs. undisturbed dust-lead**

2) This information may be used to determine whether a quantitative or semi-quantitative relationship exists for the following. Other comparisons may be made as necessary.

- **blood-lead vs. mouthing habits**

A7 DATA QUALITY OBJECTIVES

The DQO process is an iterative process which is designed to focus on the decisions that must be made and to help ensure that the site activities acquire data that are logical, scientifically defensible, and cost effective. The DQO process is intended to:

- Ensure that task objectives are clearly defined
- Determine anticipated uses of the data
- Determine what environmental data are necessary to meet these objectives
- Ensure that the data collected are of adequate quantity and quality for the intended use

Two types of DQOs are identified in this SAP/QAPP: DQOs for the overall study

objectives and criteria for measurement data. DQOs for the overall study objectives address the first three steps in the DQO process described above. These DQOs have been addressed in Section A6.2. DQO requirements that ensure data of sufficient quantity and quality are obtained are presented in the following section.

Criteria for Measurement Data

The performance criteria for measurement data generated as part of this project will be evaluated in terms of precision, accuracy, representativeness, completeness and comparability (PARCC). The following sections describe PARCC criteria. DQO criteria required for each study objective is also provided.

Precision: Precision is defined as the agreement between a set of replicate measurements without assumption or knowledge of the true value. It is a measure of agreement among individual measurements of the same property under prescribed similar conditions. Agreement is expressed as the relative percent difference (RPD) for duplicate measurements if the reported values are sufficiently above the method detection limit (MDL) (> 5 x MDL) or the absolute difference of two values near the MDL.

$$RPD = \frac{|2(A - B)|}{A + B} \times 100\%$$

$$\text{Absolute difference} = |A - B|$$

Where:

A = original concentration value of an analyte
B = duplicate concentration value of an analyte

Additionally, agreement may be expressed as the range and standard deviation for larger numbers of replicates. The appropriate precision calculation will be reported for the required duplicates, and a defined MDL will be reported as per EPA guidance in 40 CFR, part 136, Appendix B.

Field Duplicates: Field duplicates are co-located samples that are collected at the site. These samples are submitted blind to the laboratory to test both the precision of the laboratory analysis in conjunction with the precision of sample collection. Field duplicates are required to be collected at a minimum frequency of 5% of all surface soil samples collected (1 field duplicate per 20 investigation samples collected). The RPD for field duplicates should not exceed requirements outlined in Table A7.1 or, alternatively, the absolute difference should not exceed 1 x MDL. However, these acceptance limits may be arbitrary; therefore, a graphical comparison of the original and field duplicate samples should also be prepared. This comparison will include a linear regression and will report the calculated correlation coefficient (r).

Laboratory Duplicates: Laboratory duplicates are splits that are prepared in the laboratory. Because the laboratory is aware that the samples are duplicates, these samples serve to test the precision of the laboratory's sample preparation and analysis. The RPD for laboratory duplicates should not exceed requirements outlined in Table A7.1 or, alternatively, the absolute difference should not exceed 1 x MDL.

Confirmation Samples: Confirmation samples will be analyzed by XRF and confirmed using another metals analysis performed by an independent laboratory. Confirmation analyses will be performed on 20% of surface soils collected. The RPD for confirmation samples should not exceed requirements outlined in Table A7.1 or, alternatively, the absolute difference should not exceed 1 x MDL. However, these acceptance limits are arbitrary; therefore, a graphical comparison of the XRF analysis and the corresponding metals analysis should also be prepared. This comparison will include a linear regression and will report the calculated correlation coefficient (r). Due to limited samples available for soil cores, household dust, undisturbed dust, tap water, hair and urine samples, these media will not require confirmation analyses by an independent laboratory.

Table A7.1: Precision requirements for each Study Objective

Study Objective	Project QC or Laboratory QC	Precision Test	Frequency	Test Criteria
#1-1	Project QC	Field duplicates	5% of investigative samples collected (1 field duplicate per 20 investigative samples collected)	RPD < 25%[a]
	Project QC	XRF sample vs. Independent Metals Analysis Sample	20% of investigative samples (1 confirmation sample/5 investigative samples)	Prepare graphical presentation of XRF vs. Metals samples which reports a linear regression
	Laboratory QC	XRF Method duplicates	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
	Laboratory QC	Independent Metals Analysis duplicates	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
#1-2	Project QC	Field duplicates	5% of investigative samples collected (1 field duplicate per 20 investigative samples collected)	RPD < 25%[a]
	Project QC	XRF sample vs. Independent Metals Analysis Sample	20% of investigative samples (1 confirmation sample/5 investigative samples)	Prepare graphical presentation of XRF vs. Metals samples which reports a linear regression

Study Objective	Project QC or Laboratory QC	Precision Test	Frequency	Test Criteria
	Laboratory QC	XRF Method duplicates	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
	Laboratory QC	Independent Metals Analysis duplicates	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
#1-3	Laboratory QC	XRF Method duplicates	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
	Laboratory QC	Independent Metals Analysis duplicates	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
#1-4	Laboratory QC	Independent Metals Analysis duplicates	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
#2-1	Laboratory QC	Method duplicates for indoor household dust	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
	Laboratory QC	Method duplicates for undisturbed dust	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]

Study Objective	Project QC or Laboratory QC	Precision Test	Frequency	Test Criteria
#2-2	Laboratory QC	Method ~~duplicates for tap water~~	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 20%[b]
#2-3	Project QC	~~Field duplicates for lead paint~~	5% of homes screened (1 duplicate per 20 investigative samples)	RPD < 25%[a]
#3-1	Laboratory QC	Method duplicates for urine arsenic	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
	Laboratory QC	Method duplicates for hair arsenic	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 25%[b]
#3-2	Laboratory QC	Method duplicates for blood lead	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	RPD < 20%[b]
#3-3	Project QC	Have team member review the interview sheets to ensure all information has been obtained	100% of the completed interview sheets	N/A

N/A – Not applicable

a – Perform absolute difference calculation as described above for analytical results near the MQL. Also prepare a graphical presentation which reports the linear regression.

b – Perform absolute difference calculation as described above for analytical results near the MQL.

Accuracy: Accuracy is a measure of the closeness of individual measurements to the "true" value. Accuracy usually is expressed as a percentage of that value. For a variety of analytical procedures, standard reference materials traceable to or available from National Institute of Standards and Technology (NIST) or other sources can be used to determine accuracy of measurements. Accuracy will be measured as the percent recovery (%R) of an analyte in a series of reference standards that span the linear range of the instrument. Specific accuracy guidelines for other accuracy measurements such as calibration verification standards are detailed in the SOPs (See Appendix A).

$$\%R = \frac{A}{B} \times 100\%$$

Where:

A = measured concentration value of an analyte
B = true (known) concentration value of an analyte

Accuracy will be measured by performing analysis of matrix spike (MS) samples and laboratory control samples (LCSs).

Matrix Spike: A matrix spike sample is an investigative sample having a matrix that is representative of all investigative samples to which a known concentration of target analytes is added. This quality control sample measures the extent that the sample matrix affects the accuracy of reported target analytes.

Laboratory Control Sample: A LCS originates in the laboratory or is provided as a standard reference material (SRM) by a manufacturer (e.g. NIST) and contains target analytes of known concentration. Because LCSs are independent of the calibration standards, they are analyzed to verify the accuracy of the standards used to calibrate the instrument. At least one LCS must be analyzed in each analysis batch and analytical results must fall within manufacturer's limits.

Table A7.2: Accuracy requirements for each Study Objective

Study Objective	Project QC or Laboratory QC	Accuracy Test	Frequency	Test Criteria
#1-1	Laboratory QC	MS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	75-125 %R
	Laboratory QC	LCS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	Manufacturer's Limits
#1-2	Laboratory QC	MS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	75-125 %R
	Laboratory QC	LCS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	Manufacturer's Limits
#1-3	Laboratory QC	MS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	75-125 %R
	Laboratory QC	LCS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	Manufacturer's Limits
#1-4	Laboratory QC	MS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	75-125 %R
	Laboratory QC	LCS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	Manufacturer's Limits

Study Objective	Project QC or Laboratory QC	Accuracy Test	Frequency	Test Criteria
#2-1	Laboratory QC	MS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	75-125 %R
	Laboratory QC	LCS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	Manufacturer's Limits
#2-2	Laboratory QC	MS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	75-125 %R
	Laboratory QC	LCS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	Manufacturer's Limits
#2-3	Project QC	LCS	5% of homes screened (1 duplicate per 20 investigative samples)	80-120 %R
#3-1	Laboratory QC	MS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	75-125 %R
	Laboratory QC	LCS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	Manufacturer's Limits
#3-2	Laboratory QC	LCS	5% of investigative samples per analytical batch (1 duplicate per 20 investigative samples)	Manufacturer's Limits
#3-3	N/A	N/A	N/A	N/A

MS – Matrix Spike
LCS – Laboratory Control Sample
%R – Percent Recovery
N/A – Not applicable

Representativeness: Representativeness is defined as the degree to which data accurately and precisely describe the general characteristics of a population or the parameter variations at a sampling point. It is important to determine whether samples collected for this investigation are representative at both levels.

Representativeness for the Sample Population: The sample populations chosen to fulfill each Study Goal have been selected using various sampling strategies. Details and rationale for each sample population are discussed below.

Study Goal #1:

Impacted Residences

A biased sampling strategy has been chosen to investigate 5 residences where soil removal actions may be necessary. This sampling strategy will serve to produce a sample population that will be representative of those residences where highest lead and arsenic concentrations were reported by UOS. This quantity of residences (N=5) was chosen in order to generate sufficient data to perform meaningful statistical evaluations of results while minimizing the analytical costs related to this intensive sampling effort.

Unimpacted Residences

A pseudo-random sampling strategy, stratified into 3 concentration ranges below the removal action level for arsenic (As < 400 ppm), has been chosen to be investigated for 3 unimpacted residences. One sample will be randomly selected from each of the following concentration ranges:

Arsenic Concentration Range (ppm)
$44 \leq [As] < 100$
$100 \leq [As] < 200$
$200 \leq [As] < 400$

Samples will be randomly chosen within each concentration range must not fall on the same streets for which Impacted Residences have been chosen. These residences have been chosen to produce a sample population (N=3) that will be representative of those properties where soil removal actions are not anticipated to be required.

Soil Cores

Core samples will be randomly identified within each section (front yard or back yard) of the residence planned for sampling. Because the residences sampled will be those where both the highest and lowest arsenic and lead levels are expected, this biased sampling strategy should produce a sample population (N=32) that will be representative of the site.

PCOC Metals Quantification

When arsenic results for surface and core soils obtained during this investigation are available, these soil samples will be stratified into arsenic concentration ranges. Samples identified for further metals characterization will be randomly selected from each of four concentration ranges such as the example presented below.

Category	Concentration Range
Low	0 < [As] < 200 ppm
Medium-Low	200 ≤ [As] < 600 ppm
Medium-High	600 ≤ [As] < 1000 ppm
High	[As] ≥ 1000 ppm

This pseudo-random, stratified sampling strategy will serve to produce a sample population that will be representative of the site.

Study Goal #2:
A biased sampling strategy has been chosen to investigate potential sources of arsenic, cadmium, lead and zinc in various environmental media where removal actions are planned. This sampling strategy will serve to produce a sample population that will be representative of those residences where elevated metals concentrations are likely to be present.

Study Goal #3:
A biased sampling strategy has been chosen to investigate biological media for the purpose of determining the extent to which acute or subchronic lead or arsenic exposure may be observed in homes where soil removal is planned.

Comparability: Data are comparable if collection techniques and measurement procedures are equivalent for the samples within a sample set. Comparable data will be obtained by specifying standard units for physical measurements and standard procedures for sample collection, processing, and analysis. See the attached SOPs (Appendix A) for sampling and for analytical procedures.

Completeness: Data are considered complete when a prescribed percentage of the total measurements and samples that are planned are actually obtained.

Data Collection (except analytical data): Due to the limited quantity of residences planned for environmental sample collection, every effort will be made to collect all the data prescribed within this SAP/QAPP; however, a minimum completeness goal will not be identified. Likewise, efforts will be made to maximize participation in the biomonitoring and demographic data collection while minimizing the nuisance to the residents. It is therefore, not reasonable to prescribe a minimum completeness goal for these aspects of the project. However, any data gaps encountered and the potential impact of the gaps will be discussed in the report detailing findings (Section D2.2).

Analytical Data Produced by Laboratories: Data, produced by an analytical laboratory, must be valid for at least 90% of analyzed samples. This means that fewer than 10% of all analytical data generated for each analysis method may incur a qualification of unusable (R qualification). If this completeness goal is not met, the analytical laboratory responsible for generating the poor quality data must reanalyze samples without additional cost and reanalyses must adhere to method requirements to generate valid data.

Detection Limits (applicable to chemical analyses only): MDLs are minimum concentration of a substance that can be measured and reported with 99% confidence that the true value is greater than zero (3σIDL). The method quantitation limits are the minimum values that can quantify that analyte with reasonable scientific confidence (10σ IDL). The method quantitation limits established for the analytical methodologies to be employed for this effort are presented in the next section (Section B).

A9 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATION

Personnel responsible for completing this project include toxicologists, analytical chemists, phlebotomists and geologists. These technically-trained personnel have been chosen to participate in the investigation because they are experienced in conducting sampling programs, chemical measurements on a variety of analytical instrumentation and performing interpretation of data generated from the sampling program.

Personnel retained for field sampling activities must be OSHA 40 Hour HAZWOPER certified. Field sampling personnel must also be familiar with the sampling protocols (SAP/QAPP) and must ensure that all project requirements for sampling are met. Personnel retained for blood collection must be a certified pediatric phlebotomist.

A10 DOCUMENTATION AND RECORDS

Maintenance of pertinent documentation is critical for evaluating the success of the investigation. This section describes the laboratory requirements for preparing data packages for this project. In addition, procedures for storing and maintaining laboratory data are described in this section. Documentation describing sample handling and custody requirements are discussed in Section B3 of this SAP/QAPP.

A10.1 Laboratory Data

Contract Laboratory Program (CLP)-like data packages will be required for all laboratory analytical data. These CLP-like data packages will include a case narrative, copies of all associated raw data, sample results and all associated QC summaries. A summary of the data package requirements is shown on the next page:

Section I **Case Narrative**

1. Case narrative
2. Copies of nonconformance/corrective action forms
3. Copies of sample receipt notices
4. Internal tracking documents, as applicable
5. Copies of all chain-of-custody forms

Section II **Analytical Results** - All results will be reported on a dry weight basis.

1. Results for each parameter including dilutions and reanalysis (dry-weight basis)
2. Units of measure
3. Method Quantitation Limit
4. Date of sample analysis
5. Date of sample receipt
6. Date of sampling
7. Dilution factor

Section III **QA/QC Summaries**

1. Method blanks, continuing calibration blanks, preparation blanks
2. Initial and continuing calibration verifications
3. Inductively Coupled Plasma (ICP) interference check samples
4. Matrix spikes and post-digestion spikes
5. Method duplicate samples
6. Laboratory control samples
7. Method of standard additions
8. ICP serial dilution
9. Instrument detection limits

Section IV **Instrument Raw Data** – Sequential measurement readout records for XRF, ICP, graphite furnace atomic absorption (GFAA), which will include the following information:

1. Environmental samples, including dilutions and reanalyses
2. Initial calibration (including reporting whether $r \geq 0.995$)
3. Initial and continuing calibration verifications
4. Method blanks, continuing calibration blanks and preparation blanks
5. ICP interference check samples
6. Matrix spike and post-digestion spikes
7. Matrix duplicate samples
8. Laboratory control samples
9. Method of standard additions
10. ICP serial dilution

Section V **Other Raw Data**

1. Sample digestion and preparation logs
2. Instrument analysis logs for each instrument used
3. Standard preparation logs, including initial and final concentrations for each standard used

Section VI **Electronic Data** – All analytical data will be supplied in electronic form as well as hardcopy form. All data will be provided in an Office '97 Excel® spreadsheet. An example spreadsheet format has been developed and is attached (Figure A10.1).

A10.2 Data Management

Hardcopy Data

Hardcopies of analytical data will be provided by all analytical laboratories. These data will be reviewed by ISSI and a copy provided to EPA for their records.

Electronic Data

Electronic data will be provided by all ISSI subcontractors in Office '97 Excel® spreadsheet formats provided in Figure A10.1. These data will be verified with hardcopy analytical results to ensure no transcription errors have occurred. These data will then be imported into and maintained in an Access® database or an Excel® spreadsheet. The database or spreadsheets will be used by ISSI to perform statistical calculations and trend evaluations. Results of database queries will be incorporated into a report, described in Section D2.2, which will be submitted to EPA's Regional Toxicologist, Dr. Chris Weis.

B MEASUREMENT AND DATA ACQUISITION

This section describes the site investigation design and implementation, including method for sample collection, handling and analysis. In addition, field and laboratory QC procedures and instrument testing, inspection, maintenance and calibration requirements are described.

B1 SAMPLING PROCESS DESIGN

The sampling process design is described in this section. Sampling process design includes descriptions of the sampling locations, number of samples planned for collection, sample matrices and the measurement of field parameters.

B1.1 Identification of Sample Locations

Rationale for sample location identification may be divided into two portions: 1) grid sampling for Intensive Surface and Core Soil Sampling Phase; and 2) sample locations for Environmental and Biomonitoring Sampling Phase. Each of these is described below.

INSERT FIGURE A10.1 HERE

Grid Sample Locations

Eight residences (5 impacted and 3 unimpacted) have been identified for intensive grid sampling (Table B1.1.1). Surface soil samples will be collected in the adjacent yards providing residents will grant permission for the sampling teams to gain access. A 5'x 5' grid will be imposed over the residence and 15 feet into adjacent residences having contiguous yards. Samples will not be collected from the alleyways at the rear of the residences. Surface soil samples will be collected at each grid node or the point closest to that grid node if obstructions are noted. Figure B1.1.1 presents the proposed sampling design for intensive surface soil sampling. In addition, 4 soil cores will be collected at the residence, 2 cores in the front yard and 2 cores in the back yard.

Individual samples will be identified using the following procedure:

- Field personnel will draw a picture of the target residence and the adjoining properties in the field logbook. The 5' x 5' grid will be superimposed over the drawing of the residence.
- Surface soil samples will be individually numbered and these numbers will be noted on the drawing in the field logbook.
- Each sample number will be identified using a four-part sampling code as described in Section B2.2.

Numbering assignments will begin at first grid node located at the northwesternmost corner of the yard. This sample will be identified as 001. Sample numbers will increase going east (002, 003, 004, etc.) until there are no more grid nodes on that row identified for sampling at the residence. The sample numbering will continue on the next row of grid nodes directly south of the first grid node (001) and will increase again going east until there are no more grid nodes on that row. Numbering will continue until there are no more grid nodes identified for sampling on the residence. Sample number assignments for adjoining residences will be identified as a unique samples (since the address is different) and will be assigned using the sample protocols described above.

Insert Figure B1.1.1

In order to maintain confidentiality, the addresses for residences slated for this investigation have been assigned a Residence Code. The 8 residences identified for intensive soil sampling are provided in Table B1.1.1.

Table B1.1.1: Residences Identified for Intensive Surface Soil and Core Sampling

Target Residence Definition	Residence Code	Arsenic Concentration[a] (ppm)
Impacted	A	5600
	B	530
	C	1700
	D	2600
	E	780
Unimpacted	F	98 J
	G	140 J
	H	350

a – Highest concentration measured at each property.

Environmental and Biomonitoring Sample Locations
This phase of sampling will proceed after residences requiring soil removal action are identified. The arsenic or lead surface soil concentrations above removal action levels for the 37 residences will be confirmed. Any residences where arsenic and lead concentrations are confirmed to be greater than 400 ppm arsenic and/or 2000 ppm lead will be scheduled for removal actions. All residences, identified for soil removal action, will be sampled or field analysis performed for the following environmental and biologic media before any soil is removed from the residences.

Environmental Samples:

- field analysis of exterior and interior paint (lead only)
- indoor household dust (arsenic, cadmium, lead)
- undisturbed dust (arsenic, cadmium, lead)
- tap water (lead only)
- garden vegetables (arsenic, cadmium, lead)
- surface soil samples co-located with garden vegetables (arsenic, cadmium, lead)

Biological Samples:

- Arsenic in composite hair samples
- Inorganic arsenic in first void urine samples
- Blood lead

B1.2 Measurement of Field Parameters

~~Analysis of exterior and interior paint screening will be performed using portable~~ XRF *lead paint analyzers on painted surfaces including interior and exterior walls and trim.* The lead paint analyzer must be calibrated everyday prior to use at each residence. All calibration and analytical measurements must be documented in the field logbook. Calibration procedures and lead paint measurements will be performed in accord with the SOP (Appendix A).

B2 SAMPLING METHOD REQUIREMENTS

The following sampling method requirements will be discussed in this section:

- Identification of sampling protocols to be used
- Field sample identification procedures
- Decontamination procedures

B2.1 Sampling Protocols

Samples will be collected according to SOPs provided in Appendix A. Procedures outlined in these SOPs include:

- Surface Soil Sampling and Sieving
- Tap Water Collection
- Indoor Household Dust Collection
- Indoor Undisturbed Dust Collection
- Interior/Exterior ~~Paint Screening~~
- Blood Lead Sampling
- Collection of Urine Samples for Arsenic
- Collection of Hair Samples for Arsenic
- Collection of Garden Vegetables

<u>Soil Core Samples</u>
Because surface soil to a depth of 12 inches is presently too dry to support standard coring methods, collection of soil cores will be performed by digging a pit to a depth of 12 inches. Soil core depth of 12 inches has been chosen because this is the maximum depth to which any soil removal actions will occur. After the pit is opened, a photograph will be taken. The photograph will serve to document any soil stratification observed for that core. The photograph will be given an identification number and both a description of the photograph and the identification number will be noted in the field logbook. The number for each photo will be the same sample identification number assigned to the soil core. If a distinct stratification of soil material is noted during soil core collection (eg. native material vs. fill material), the soil will be divided into 2 portions along the observed soil stratification.

Surface Soil Samples Co-located with Garden Vegetables

Surface soil samples that are co-located with any garden vegetables that are collected will also be obtained. The SOP for Surface Soil Sampling and Sieving (Appendix A) must be followed using the guidelines for surface soil compositing. A composite sample of garden soil consisting of 6 subsamples will be collected. The 6 subsamples will be collected along the entire vegetable bed.

A summary of required sample containers, preservation, analytical instrumentation and holding times is presented in Table B2.1.1.

Table B2.1.1: Summary of Sample Containers, Preservation, Analysis Methods and Holding Times

Sample Media Collected	Target Analytes	Sample Container	Sample Preservation	Sample Holding Time[a]	Analytical Instrumentation
Environmental					
Indoor House Dust	As, Cd, Pb	Filter Cartridge	None.	180 days	XRF
~~Undisturbed~~ Dust	As, Cd, Pb	Filter Cartridge	None.	180 days	XRF
Tap Water	Pb	1 500-mL HDPE bottle 1 1-L HDPE bottle	~1 mL Conc. HNO_3 acid (pH<2)	180 days	GFAA
Interior & Exterior Paint	Pb	N/A	N/A	N/A	Portable XRF
Garden Vegetables	As, Cd, Pb	Zip-lock Storage bags	None.	180 days	GFAA
Surface Soil Samples Co-located with Garden Vegetables	As, Cd, Pb	4-oz wide mouth glass jar or zip-lock bags	None.	180 days	XRF
Biological					
Hair	As	Plastic vial w/ screw-on cap	None.	180 days	Hydride Generation AA
Urine	As	Plastic, sterile urine cup	Refrigerate		Hydride Generation AA
Blood	Pb	6-mL lavender top Vacutainer™ tube	EDTA, Refrigerate		GFAA

XRF – X-ray Fluorescence
GFAA – Graphite Furnace Atomic Absorption
HDPE – High Density Polyethylene
HNO_3 – Nitric
N/A – Not applicable
AA – Atomic Absorption
a – Holding time is calculated from sampling date.

B3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

B3.1 Chain-of-Custody

Rationale: To ensure that collected samples are properly tracked and maintained in proper custody.

All samples collected in the field will be submitted to the appropriate analytical laboratory under chain-of-custody. All sample transfers must adhere to chain-of-custody procedures detailed below.

Sample custody history of each sample and its handling will be documented on a chain-of-custody (COC) form covering all transfers of custody until arrival at the analytical laboratory. These forms are prepared in triplicate on carbonless forms. Each COC form will identify the samples included in the sample delivery group (SDG) and the required analyses. The following information should be included on each COC form:

Client Name -	Enter ISSI, Inc.
Address -	Enter 999 18th Street, Suite 1180; Denver, CO 80202
Phone No. -	Include the phone number of the contact at ISSI (292-4142 x235).
Fax No. -	Include the facsimile number of the contact at ISSI (292-4926).
Date -	Enter the date the COC form was prepared.
Page -	Indicate page number and total number of COC pages in the SDG.
Project Name -	Enter the name of the project (Vasquez Boulevard and I-70 Residential Risk-based Sampling – Stage I Investigation).
Send Report to -	Indicate the contact name to whom the report should be sent (Mary Goldade).
Sampler Name/Signature -	Sampler's name.
Sample Number -	Note each discrete sample ID included in the SDG.
Sampling Date/Time-	Enter the specific date and time the sample was taken.
Preservative -	Indicate the type of preservative used. If no preservative was required, write "none".
Container Size/Type -	Indicate the container type and size (where applicable).
Sample Description-	Mark the sample matrix.
Analysis Required -	Indicate the method reference and name of analyses required. In the boxes below, mark an "X" to indicate the analysis is required for the respective sample ID.
Comments -	Any notes of interest (sample condition, etc.) are entered here.
Relinquished by-	The person transferring the samples signs his name here.
Date-	The person transferring the samples enters the date of relinquishment.
Company-	The person transferring the samples enters his company name.
Time-	The person transferring the samples enters the time relinquished.
Received by-	The person accepting the samples signs his name here.
Date-	The person accepting the samples enters the date of relinquishment.
Company-	The person accepting the samples enters his company name.
Time-	The person accepting the samples enters the time relinquished.

Each complete COC form will be reviewed for accuracy and clarity by the sampler and then signed by the sampler or On Scene Coordinator prior to sample shipment or transfer of custody. When the samples are handed over to a designated lab courier, the courier will compare sample inventory with the COC form to ensure accuracy. The COC forms are then signed by the courier to serve as written acknowledgment that the samples have been transferred in tact to the courier. The sampler will be given a copy of the COC form with release signatures. One copy will be retained by COC form initiator. When the samples arrive at the laboratory, the lab's sample custodian will document the date and time of receipts and condition of the samples (temperature of samples, note any damage, etc.).

Third party custody will be required when samples are shipped. Third parties include shipping companies such as FED EX, UPS and USPS. Samples will be shipped overnight in tightly sealed ice chests. All packing procedures will conform to appropriate IATA and/or DOT requirements. Third party couriers or clerks will not sign for relinquishment on COC forms. Instead, copies the shipping/tracking forms will be retained as documentation of transfer of custody. The COC form which corresponds to the samples being shipped will be sealed inside the shipping container but inside a plastic zip-lock bag and taped to the cooler lid to avoid water damage from ice.

All corrections to the chain-of-custody record will be initialed and dated by the person making the corrections. Each chain-of-custody form will include signatures of the appropriate individuals indicated on the form. The originals will accompany the samples to the laboratory, and copies documenting each custody change will be recorded and kept on file.

Chain-of-custody will be maintained until final disposition of the samples by the laboratory and acceptance of analytical results by EPA.

B3.2 Field Documentation

All sampling procedures will be documented in a field logbook. These general guidelines for maintaining field documentation will be used:

- Documentation will be completed in permanent black or blue ink.
- All entries will be legible
- Errors will be corrected by crossing out with a single line, dating and initialing the lineout.

Field personnel will use bound field logbooks with sequentially numbered pages to maintain field records. The following information will be recorded in the field logbook:

- Name and affiliation of all personnel or visitors on site
- Weather conditions during the field activity
- Chronology and summary of daily activities
- Notes of conversations with coordinating officials
- Identification numbers of field instruments used
- Results of calibrations and field measurements
- Documentation of sampling activities, including data and time of sample collection and names of sampling personnel
- Decontamination episodes
- Reference to other field logbooks or forms that contain related information
- Discussion of problems encountered and the resolution obtained
- Discussion of deviation from the SAP/QAPP
- Description of any photographs taken, including date, time, direction, photo ID and photographer
- Record of QC samples collected

B3.3 Sample Archives

All surface soil, soil cores and dust samples must be retained in a dry and secure storage facility. A portion of samples may be identified for further characterization; therefore samples must be stored in such a manner that quick retrieval is possible. All investigative samples will be held in storage, under chain-of-custody until the RPM indicates that these samples may be disposed according to proper waste disposal methods.

B4 ANALYTICAL METHOD REQUIREMENTS

This section provides the details necessary to prepare and analyze surface soil samples to meet project objectives and quality control (QC) requirements. Methods described in this section include: sample preparation and metals analysis for a variety of media.

B4.1 Sample Preparation

All surface soils must be prepared before any analytical measurements are made. Soils will be air-dried for a minimum of 8 hours prior to sieving. Following drying each sample must be sieved into a fine fraction. Fines are sieved to a grain size of less than 250 μm. Procedures for sieving and decontamination of sieving equipment are outlined in the standard operating procedures (SOP) located in Appendix A.

B4.2 Metals Analysis

The primary method for quantification of arsenic and lead for surface soils will be via XRF. Twenty percent of samples identified for XRF analysis will also be confirmed using another analytical method. Specifically, samples identified for confirmation analyses will be sieved into a <250 µm size fraction, then split and submitted to a contract laboratory for metals analysis. Analysis of tap ~~water,~~ ~~dust,~~ ~~blood~~ lead, urine arsenic, hair ~~arsenic, garden~~ ~~vegetables and~~ surface ~~soils co-located with garden~~ vegetables will be submitted to an analytical ~~laboratory for standard metals~~ analyses. Due to anticipated limited sample volumes, these samples will not require confirmation analyses.

B4.2.1 Detection Limit Requirements

A preliminary health-related goal (HRG) concern for a resident at a cancer risk of 1E-4 was calculated for arsenic. The preliminary HRGs for all metals but arsenic was determined based upon a hazard quotient (HQ) equal to 1. These values are presented in Tables B4.2.1 and B4.2.2. A detailed summary of the calculations for the health-related goals is presented in Appendix B. All analytical methods utilized must be able to achieve the method quantitiation limits (MQLs) for all target analytes provided below.

Table B4.2.1 Health-Related Goals and Target Method Quantitation Limits for Environmental Samples

Target Analyte	Risk-based Assumptions	Health-related Goals		Method Quantitation Limit (MQL)	
		Soil/Solid[a] (mg/kg)	Water (mg/L)	Soil/Solid[a] (mg/kg)	Water (mg/L)
Environmental Samples – Standard 5 Metals					
Arsenic	Risk = 1E-4	35	N/A	10	N/A
Cadmium	HQ = 1	92	N/A	10	N/A
Lead	HQ = 1	400	10	40	0.002
Zinc	HQ = 1	28,000	N/A	25	N/A
Environmental Samples – PCOCs Evaluation					
Aluminum	HQ = 1	92,000	N/A	5	N/A
Antimony	HQ = 1	37	N/A	10	N/A
Barium	HQ = 1	6,500	N/A	0.5	N/A
Beryllium	Risk = 1E-4	180	N/A	0.4	N/A
Calcium	HQ = 1	--	N/A	10	N/A
Chromium	HQ = 1	460	N/A	0.5	N/A
Cobalt	HQ = 1	5,500	N/A	0.3	N/A
Copper	HQ = 1	3,400	N/A	100	N/A
Iron	HQ = 1	28,000	N/A	10	N/A
Magnesium	HQ = 1	--	N/A	5	N/A
Manganese	HQ = 1	13,000	N/A	0.5	N/A
Mercury	HQ = 1	28	N/A	0.5	N/A
Nickel	HQ = 1	1,800	N/A	0.5	N/A
Potassium	HQ = 1	--	N/A	50	N/A
Selenium	HQ = 1	460	N/A	0.5	N/A
Silver	HQ = 1	460	N/A	0.01	N/A
Sodium	HQ = 1	--	N/A	10	N/A
Thallium	HQ = 1	7.4	N/A	1	N/A
Vanadium	HQ = 1	830	N/A	0.5	N/A

a – Reported on a dry-weight basis.
N/A – Not applicable

Table B4.2.1.2: Average Levels in Unexposed Populations and Target Method Quantitation Limits for Biological Samples

Target Analyte	Units of Measure	Average Levels in Unexposed Populations	Method Quantitation Limit (MQL)
Biological Samples			
Blood-lead	µg/dL	10	1
Hair-arsenic	µg/g	10-15	2
Urine-arsenic	µg As /g Cr	50	0.05

Cr – Creatinine
Urine arsenic will be corrected for creatinine

B4.2.2 X-ray Fluorescence

XRF analysis will quantify arsenic, cadmium, lead and zinc concentrations for the fine fraction of the surface soil sample. Procedures for XRF analysis are outlined in the SOP located in Appendix A.

B4.2.3 Metals Analyses

B4.2.3.1 Confirmation Analyses

Confirmation metals analysis will be performed for twenty percent of samples analyzed by XRF. This analysis will serve to confirm results obtained by the primary laboratory. Confirmation analyses will be performed by an independent laboratory using either of the following instrumentation: ICP/AES or ICP/MS. Procedures for metals analysis are outlined in the respective EPA SW-846 analytical methods. Approved analytical method numbers are provided in Table B4.2.3.1.1 Either of these methods may be used providing the MQL for the parameter is achievable.

Table B4.2.3.1.1: Analytical Methods for Confirmation Analysis

Instrumentation	Parameter	SW-846 Method Reference
ICP	As, Pb, Cd, Zn	6010
ICP/MS	As, Pb, Cd, Zn	6020

ICP – Inductively Coupled Plasma
ICP/MS - Inductively Coupled Plasma/Mass Spectrometry

B4.2.3.2 PCOCs Metals Analyses

The subset of surface soil and soil core samples that have been identified for additional metals analysis (PCOCs Evaluation) must be analyzed on instrumentation that is capable of achieving the MQL requirements outlined in Section B4.2.1. Procedures for metals analysis are outlined in the respective EPA SW-846 analytical methods. Approved analytical method numbers are provided in Table B4.2.3.2.1

Table B4.2.3.2.1: Analytical Methods for PCOCs Evaluation

Instrumentation	Parameter	SW-846 Method Reference
ICP	All[a] except Hg	6010
ICP/MS	All[a] except Hg	6020
CVAA	Hg	SW-846 7470/7471
GFAA	As, Pb, Cd, Cu, Se, Tl	SW-846 7000 Series

a – All metals that can meet MQL requirements on that instrumentation.

B4.2.3.3 Environmental and Biological Sample Analyses

The following environmental and biologic samples: ~~tap water, dust~~, blood lead, urine arsenic, hair arsenic, garden vegetables and surface soils co-located with garden vegetables will be analyzed using any of the methods outlined in Table B4.2.3.3.1.

Table B4.2.3.3.1: Analytical Method Requirements for Environmental and Biological Samples

Sample Medium	Parameter	Analytical Method
Tap Water	Pb	SW-846 6010, 6020 or 7421
Dust (House or Undisturbed)	As, Cd, Pb, Zn	XRF (SOP Appendix A)
Garden Vegetables	As, Cd, Pb, Zn	SW-846 6010, 6020
Co-located Surface Soils	As, Cd, Pb, Zn	SW-846 6010,6020
Blood	Pb	GFAA (SOP Appendix A)
Hair	As	Hydride Generation (SOP Appendix A)
Urine	As	Hydride Generation (SOP Appendix A)

GFAA – Graphite Furnace Atomic Absorption

B5 QUALITY CONTROL REQUIREMENTS

The principle objectives of any sampling and analysis program are to obtain accurate and representative environmental samples and to provide valid analytical data. The quality of data will be assessed through the use of QC samples performed on a regular basis. Laboratory QC samples will be analyzed as per analytical method protocols to evaluate whether laboratory procedures and analyses have been completed properly. For this project, the types of QC samples to be analyzed are defined and their role in the production of QC data are discussed in the following sections. Required QC samples are divided into sections as required by each analytical method.

In addition to the particular QC requirements identified in the subsequent sections, all analyses must be performed within holding times and must adhere to all procedures as outlined in the appropriate SOPs (Appendix A) or EPA SW-846 methods approved for this project.

B5.1 Analytical Methods

Quality control requirements for XRF and metals analyses are slightly different. Therefore, QC requirements for the two types of analyses are outlined separately.

B5.1.1 XRF Analysis

Method Blank: A method blank is composed of a matrix that is similar to investigative samples collected. For example, method blanks are composed of deionized water for water matrices and silica sand for solid matrices. Method blanks are analyzed to discern if laboratory-induced contamination is present during analysis at a frequency of at least 5% of samples analyzed (1 method blank per 20 samples analyzed or1 method blank per analytical batch, whichever is more frequent). Concentrations of target analytes must not exceed 1 x MDL.

Matrix Duplicate: A method duplicate is a sample that is split before preparation of the "XRF puck". The results of the two samples are compared to determine the precision observed. Method duplicates will be performed at a frequency of 5% (1 duplicate for every 20 investigative samples). The RPD for method duplicates is not to exceed 25%.

Laboratory Control Samples: A LCS originates in the laboratory or is provided as a standard reference material (SRM) by a manufacturer (eg. NIST) and contains target analytes of known concentration. Because LCSs are independent of the calibration standards, they are analyzed to verify the accuracy of the standards used to calibrate the instrument. At least one LCS must be analyzed in each analysis batch and analytical results must fall within manufacturer's limits.

B5.1.2 Metals Analysis

Method Blank: A method blank is composed of a matrix that is similar to investigative samples collected. For example, method blanks are composed of deionized water for water matrices and silica sand for solid matrices. Method blanks are analyzed to discern if laboratory-induced contamination is present during analysis at a frequency of 5% of samples analyzed (1 method blank per 20 samples analyzed or1 method blank per analytical batch, whichever is more frequent). Concentrations of target analytes must not exceed 1 x MDL.

Field Blank: A field blank is sample composed of a matrix that is similar to investigative samples collected and that is exposed to the field conditions in order to determine whether introduction of target analytes may be occurring during sampling. For example, field blanks will be collected for tap water and for house and undisturbed dust and will be composed of deionized water and the filter cartridge, respectively. Field blanks must be collected for appropriate matrices at a frequency of 5% of samples collected (1 field blank per 20 investigative samples collected). Concentrations of target analysis greater than 1 x MDL may suggest that field sampling-induced contamination of target analytes may have occurred.

Equipment Blank: An equipment blank is a liquid sample which is collected from during equipment decontamination. The final rinse (rinsate) is collected and analyzed to determine if equipment were adequately cleaned between sample locations. Concentrations of target analytes must not exceed 1 x MDL. Equipment blanks must be collected at a frequency of 5% (1 equipment blank per 20 equipment rinses).

Matrix Duplicate: A method duplicate is a sample that is split before digestion of the investigative sample. The results of the two samples are compared to determine the precision observed. Method duplicates will be performed at a frequency of 5% (1 duplicate for every 20 investigative samples). The RPD for method duplicates is not to exceed 25%.

Matrix Spike: The accuracy of an analytical method for a particular environmental sample matrix is evaluated by analyzing samples fortified with a known concentration of target analytes. A matrix spike is the analysis of a known concentration of target analytes added to an aliquot of the field sample. A matrix spike will be performed at a frequency of 5% (1 matrix spike for every 20 investigative samples). The percent recovery for the matrix spike is required to be 75-125%. If the matrix spike is outside of these acceptance limits and all potential error sources such as incorrect sample preparation or spiking concentrations, a post-digestion spike must be prepared and analyzed. The acceptance limits for the post-digestion spike is 85-115%.

Laboratory Control Samples: A LCS originates in the laboratory or is provided as a standard reference material (SRM) by a manufacturer (eg. NIST) and contains target analytes of known concentration. Because LCSs are independent of the calibration standards, they are analyzed to verify the accuracy of the standards used to calibrate the instrument. At least one LCS must be analyzed in each analysis batch and analytical results must fall within manufacturer's limits.

B6 INSTRUMENT/EQUIPMENT TESTING, INSPECTION AND MAINTENANCE REQUIREMENTS

Field equipment planned for use during this investigation ~~is a portable XRF lead-paint~~ analyzer. This instrument will be inspected daily to ensure it remains in good working condition. The instrument will be calibrated at the beginning of each day's use in accordance with the SOP (Appendix A). Calibrations must be acceptable before any measurements may be made. All information relating to the daily inspection, calibration and maintenance will be documented in the field logbooks.

B7 INSTRUMENT CALIBRATION FREQUENCY

Field and laboratory instrumentation, used for sample screening and analyses, will be calibrated in accordance with EPA guidance or the SOPs (Appendix A). Calibration procedures and frequencies are summarized in Appendix A. Traceable calibration standards will be obtained by the analytical laboratories. All documentation relating to the receipt, preparation and use of standards will be recorded in the appropriate laboratory logbooks.

C ASSESSMENT AND OVERSIGHT

The following sections describe activities for assessing the effectiveness of the implementation of the project and associated quality assurance/quality control (QA/QC). The purpose of the assessment is to ensure that the SAP/QAPP is implemented as prescribed. The elements include assessments and response actions and reports to management as described in the following sections.

C1 ASSESSMENT AND RESPONSE ACTIONS

Assessment of laboratory analyses will be conducted through oversight of analytical procedures by ISSI, through optional laboratory audits conducted by ISSI and/or through submittal of performance evaluation samples. Laboratory audits will evaluate laboratory procedures to ensure that they follow GLP (Good Laboratory Practices) Guidelines and to ensure that they do not conflict with project requirements. If conflicts are noted, these must be addressed so that project requirements are met. Performance evaluation (PE) samples may be used as a tool for evaluating the accuracy of laboratory analyses. PE samples are standards submitted blind to the laboratory. The concentration is unknown to the laboratory analyzing the sample, but known to the submitter (ISSI). The laboratory reported results for the PE samples will be evaluated by comparison to the certified values provided to ISSI by the PE sample vendor. Acceptance criteria in terms of percent recovery windows may be established as appropriate to determine comparability. The degree of comparability expected between the certified values and the laboratory reported results will depend on a number of factors (which will be defined by ISSI) including the accuracy and precision reported by the vendor for the certified values and the comparability of the certification analysis method used by the vendor with the analysis methods used by the laboratory. The purpose of ISSI's oversight activities will be to document analytical procedures including changes, additions or deletions that occurred which were beyond the control of the analytical laboratory.

Two types of corrective actions may result from the laboratory oversight: immediate and long-term. Immediate corrective actions include correcting deficiencies or errors or correcting inadequate procedures. Long-term corrective actions are designed to eliminate the sources of deficiencies or errors. Corrective actions may be made through additional personnel training or procedural improvement.

D DATA VALIDATION AND USEABILITY

The following sections describe the requirements and methods for data review, validation and verification. In addition, the process for reconciling the data generated with the requirements of the data user is also defined.

D1 DATA REVIEW VALIDATION AND VERIFICATION

The process of data review, validation and verification is intended to provide consistent and defensible analytical results. Analytical data generated as part of this project will be reviewed and verified before they are incorporated into the project database. Full data validation will be completed on approximately 10 percent of the data generated for this project. Abbreviated validation will be completed on all succeeding analytical data. Abbreviated and full data validation criteria are described in Section D2.

D2 VALIDATION AND VERIFICATION METHODS

Data reporting consists of communicating summarized data in a final form. QA for reporting consists of measures intended to avoid or detect human error and to correct identified errors. Such methods include specification of standard reporting formats and contents of measures to reduce data transcription errors (Section A10).

D2.1 Validation

Full Validation: Full validation will be conducted on data packages for 10% of the samples analyzed for metals via XRF and independent metals analysis. This will be performed to ensure that data were produced with sufficient quality to establish confidence in the analytical results. The following elements will be reviewed for compliance as part of the full data validation:

- Method compliance
- Holding times
- Calibration
- Blanks
- Matrix spikes
- Method duplicates
- LCSs
- Other laboratory QC specified by the method
- Detection limits
- Analyte identification
- Analyte quantitation

Abbreviated Validation: Abbreviated validation will be completed on 100% of the analytical results for which full validation was not performed. This will be performed to ensure that data were produced with sufficient quality to establish confidence in the analytical results. The following elements will be reviewed for compliance as part of the abbreviated data validation:

- Method compliance
- Holding times
- Calibration
- Blanks
- LCSs
- Matrix spikes
- Method duplicates
- Other laboratory QC specified by the method

D2.2 Final Reporting

Laboratory Reports: All raw data and summary results of both data and summary statistics (means, standard deviations, ranges, etc.) will be provided by the laboratories. This information will be incorporated into ISSI's final report. Copies of the raw analytical data packages will be submitted to EPA for archival.

Study Report: A draft report of all the summary study design characteristics, sample analyses, data quality, correlation results and resulting analytical data shall be presented by the prime contractor (ISSI, Inc.). Simple statistical tests of group treatment differences will be performed and presented as discussed in Section A7. This report will undergo technical review by EPA. If necessary, comments to the draft report will be provided to ISSI and a final report will be issued.

D3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Information obtained from the Vasquez Boulevard and I-70 Residential Risk-based Sampling – Stage I Investigation will be evaluated through the data quality assessment (DQA) process to determine if the data obtained are of the correct quality and quantity to support their intended use. The DQA process consists of five steps as summarized below (USEPA 1996b).

Review the DQOs and Sampling Design: DQO outputs will be reviewed to ensure that they are still applicable. The sampling analysis and data collection documentation will also be reviewed for completeness and consistency with DQOs.

Conduct a Preliminary Data Review: Data validation reports will be reviewed to identify any limitations associated with the analytical data. Basic statistics will be utilized where applicable and meaningful graphs of the data will prepared as described in Section A7. This information will be used to learn about the structure of the data and to identify patterns, relationships or potential anomalies/outliers.

Select the Statistical Test: The most appropriate statistical procedure for summarizing and analyzing the data will be selected based on the review of the DQOs, the sampling design and the preliminary data review. Key underlying assumptions will be identified that must hold true for the statistical procedures to be valid.

Verify the Assumptions of the Statistical Test: The statistical test will be evaluated to determine whether the underlying assumption holds or whether departures from the assumptions are acceptable given the actual data or other information about the study.

Draw Conclusions from the Data: Calculations required for the statistical test will be completed and inferences drawn as a result of these calculations will be documented.

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APPENDIX A: Extraction and Analytical Methods

APPENDIX B: Health-based Goals